

FIPS PUBLICATION CHANGE NOTICE 1993 February 1
PUBLICATION NUMBER 1-2

FIPS PUB 1-2, CODE FOR INFORMATION INTERCHANGE, ITS
REPRESENTATIONS, SUBSETS, AND EXTENSIONS.

THIS OFFICE HAS A RECORD OF YOUR INTEREST IN RECEIVING CHANGES TO THE ABOVE FIPS
PUBLICATION. THE CHANGE(S) INDICATED BELOW HAVE BEEN PROVIDED BY THE MAINTENANCE
AGENCY FOR THIS PUBLICATION AND WILL BE INCLUDED IN THE NEXT PUBLISHED REVISION TO
THIS FIPS PUBLICATION. QUESTIONS OR REQUESTS FOR ADDITIONAL INFORMATION SHOULD BE
ADDRESSED TO THE MAINTENANCE AGENCY:

Department of Commerce

National Institute of Standards and Technology Computer Systems
Laboratory

CHANGE ITEM(S)

FIPS PUB 1-2, Code for Information Interchange, Its
Representations, Subsets, and Extensions, adopts ANSI X3.4-1977,
X3.32-1973, and X3.41-1974.

The American National Standards Institute (ANSI) has replaced these
standards with the following:

- ANSI X3.4-1986, Coded Character Sets - 7-Bit American National
Standard Code for Information Interchange (7-Bit ASCII)

- ANSI X3.32-1990, Graphic Representation of the Control
Characters of American National Standard Code for Information
Interchange (ASCII)

- ANSI X3.41-1990, Code Extension Techniques for Use with the 7-
Bit Coded Character Set of American National Standard Code for
Information Interchange (ASCII)

Specific Changes

Page 1, Cross Index, and Page 3, Specifications: Replace referenced
specifications with the above.

Order FIPS PUB 1-2, which includes the replaced American National
Standards listed above, from:

National Technical Information Service (NTIS)

Attn: Sales Office, Sills Building

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Office Hours - 7:45 a.m. to 5:00 p.m.

FIPS PUB 1-2

Supersedes FIPS PUBS 1-1, 7, 15, 35, and 36

FEDERAL INFORMATION
PROCESSING STANDARDS PUBLICATION
1984 NOVEMBER 14

CODE FOR INFORMATION INTERCHANGE,
ITS REPRESENTATIONS,
SUBSETS, AND EXTENSIONS

CATEGORY: HARDWARE AND SOFTWARE STANDARD
SUBCATEGORY: INTERCHANGE CODES, MEDIA, AND DATA FILES

Foreword

The Federal information Processing Standards Publication Series of the National Bureau of Standards is the official publication relating to standards adopted and promulgated under the provisions of Public Law 89-306 (Brooks Act) and under Part 6 of Title 15, Code of Federal Regulations. These legislative and executive mandates have given the Secretary of Commerce important responsibilities for improving the utilization and management of computers and automatic data processing in the Federal Government. To carry out the Secretary's responsibilities, the NBS, through its institute for Computer Sciences and Technology, provides leadership, technical guidance, and -coordination of Government efforts in the development of guidelines and standards in these areas.

Comments concerning Federal Information Processing Standards Publications are welcomed and should be addressed to the Director, Institute for Computer Sciences and Technology, National Bureau of Standards, Gaithersburg, MD 20899.

James H. Burrows, Director Institute for Computer
Sciences and Technology

Abstract

This publication provides a standard coded character set and a recommended collating sequence, subsets, extensions, and certain graphic representations for the set, all for use in Federal information processing systems, communications systems, and related equipment, that are procured by the Federal Government. This Federal Information Processing Standard adopts in whole three voluntary industry standards:

a. American National Standard X3.4-1977, Code for Information Interchange (ASCII).

b. American National Standard X3.32-1973, Graphic Representation of the Control Characters of American National Standard Code for Information Interchange.

c. American National Standard X3.41-1974, Code Extension Techniques for Use with the 7-Bit Coded Character Set of American National Standard Code for Information Interchange.

Twenty-seven other related international, national, and Federal standards are also listed.

Key words: ASCII; character coded information; code extension; coded character set; communications systems; computer systems; computers; data systems; Federal Information Processing Standard; information interchange; subset.

Federal Information
Processing Standards Publication 1-2
1984 November 14
Announcing the Standard for

CODE FOR INFORMATION INTERCHANGE, ITS REPRESENTATIONS,
SUBSETS, AND EXTENSIONS

Federal Information Processing Standards Publications are issued by the National Bureau of Standards pursuant to section 111 (f)(2) of the

Federal Property and Administrative Services Act-of 1949, as amended, Public Law 89-306 (79 Stat. 1127; 40 U.S.C. 759(f)), Executive Order 11717 (38 FR 12315, dated May 11, 1973), and Part 6 of Title 15, Code of Federal Regulations (CFR).

Name of Standard: Code for Information Interchange, Its Representations, Subsets, and Extensions. (The Code for Information Interchange is commonly known as ASCII (pronounced "as'key"), an acronym for American Standard Code for Information Interchange.).

Category of Standard: Hardware and Software Standard.
Subcategory: Interchange Codes, Media, and Data Files.

Explanation: This standard specifies a coded character set and a recommended collating sequence, subsets, extensions, and certain graphic representations for the set, all for use in Federal information processing systems, communications systems, and related equipment, that are procured by the Federal Government. Related equipment includes all character-oriented devices and media, such as printers, teleprinters, display devices, keyboards, magnetic tape in the form of reels, cassettes or cartridges, flexible disks, optical or magnetic character readers and printers or embossers,

punched cards, perforated tape, or other interchangeable media that are produced for input to a computer based system or received as output from a computer based system. This standard also applies to the data interchanged in or through such systems and equipment. Data systems to which this standard is applicable include any structured arrangement of character-oriented records, files, or indices.

This Federal ADP standard does not extend to the internal structure of the central processing unit or peripheral devices. In general, therefore, computers may operate in any mode and use any internal code which the equipment manufacturer deems most efficient.

Additional control functions for many types of equipment such as character imaging devices are given in FIPS PUB 86, Additional Controls for Use with ASCII. Instructions for implementing the standard code and its extensions, in various media, are given in other FIPS PUBS cited below in the section on "Related Documents." Information concerning the use of this standard in communications systems that are a part of the National Communications System may be obtained from the Manager, National Communications System, Attention: NCS-TS, Washington, DC 20305-2010.

Approving Authority: Secretary of Commerce.

Maintenance Agency: Department of Commerce, National Bureau of Standards (Institute for Computer Sciences and Technology).

Cross Index:

- a. American National Standard X3.4-1977 Code for Information Interchange (ASCII).
- b. American National Standard X3.32-1973, Graphic Representation of the Control Characters of American National Standard Code for Information Interchange.
- c. American National Standard X3.41-1974, Code Extension Techniques for Use with the 7-Bit Coded Character Set of American National Standard Code for Information Interchange.

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Related Documents:

- a. International Standard ISO 646-1983, 7-Bit Coded Character Set for Information Interchange.
- b. CCITT Recommendation V.3, 1972, International Alphabet No. 5.
- c. International Standard ISO 4873-1979, 8-Bit Coded Character Set for Information Interchange.
- d. International Standard ISO 2022-1982, Code Extension Techniques for Use with the ISO 7-Bit Coded Character Set.
- e. International Standard ISO 2375-1974, Procedure for Registration of Escape Sequences.
- f. American National Standard X3.64-1979, Additional Controls for Use with American National Standard Code for Information Interchange.
- g. International Standard ISO 6429-1983, Additional Control Functions for Character Imaging Devices.
- h. American National Standard X3.28-1976, Procedures for the Use of the Communication Control Character of American National Standard Code for Information Interchange in Specified Data Communication Links.
- i. American National Standard X3.57-1977, Structure for Formatting Message Headings for Information Interchange using the American National Standard Code for Information Interchange for Data Communication Systems Control.
- j. American National Standard X4.23-1982, Keyboard Arrangement for Alphanumeric Machines.
- k. FIPS PUB 2-1, Perforated Tape Code for Information Interchange (adopts ANSI X3.6-1965, reaffirmed in 1983).
- l. FIPS PUB 3-1, Recorded Magnetic Tape for Information Interchange (800 CPI, NRZI) (adopts ANSI X3.22-1973) FIPS PUB 14-1, Hollerith Punched Card Code (adopts ANSI X3.26-1980).
- n. FIPS PUB 16-1, Bit Sequencing of the Code for Information Interchange in Serial-by-Bit Data Transmission (adopts ANSI X3.15-1976).
- o. FIPS PUB 17-1, Character Structure and Character Parity Sense

for Serial-by-Bit Data Communication in the Code for Information Interchange (adopts ANSI X3.16-1976).

p. FIPS PUB 18-1, Character Structure and Character Parity Sense for Parallel-by-Bit Data Communication in the Code for Information Interchange (adopts ANSI X3.25-1976).

q. FIPS PUB 25, Recorded Magnetic Tape for Information Interchange (1600 CPI, Phase encoded) (adopts ANSI X3.39-1973).

r. FIPS PUB 32-1, Optical Character Recognition Character Sets (adopts ANSI X3.17-1977 for OCR-A and ANSI X3.49-1975 for OCR-B).

s. FIPS PUB 33-1, Character Set for Handprinting (adopts ANSI X3.45-1982).

t. FIPS PUB 50, Recorded Magnetic Tape for Information Interchange, 6250 cpi (246 cpmm), Group Coded Recording (adopts ANSI X3.54-1976).

u. FIPS PUB 51, Magnetic Tape Cassettes for Information Interchange (3.810 mm [0.ISO inch] Tape at 32 bpmm (800 bpi),, Phase Encoded) (adopts ANSI X3.48-1977).

v. FIPS PUB 52, Recorded Magnetic Tape Cartridge for Information Interchange, 4-Track, 6.30 mm (1/4 inch), 63 bpmm (1600 bpi), Phase Encoded (adopts ANSI X3.56-1977).

w. FIPS PUB 79, Magnetic Tape Labels and File Structure for Information Interchange (adopts ANSI X3.27-1978 with qualifications).

x. FIPS PUB 86, Additional Controls for Use with American National Standard Code for Information Interchange (adopts ANSI X3.64-1979).

y. FIPS PUB 91, Magnetic Tape Cassettes for Information Interchange, Dual Track Complementary Return-to-Bias (CRB) Four-States Recording on 3.81-mm (0.ISO-in) Tape (adopts ANSI X3.59-1981).

z. FIPS PUB 93, Parallel Recorded Magnetic Tape Cartridge for Information Interchange 4-Track, 630 mm (1/4 inch), 63 bpmm (1600 bpi) Phase Encoded (adopts ANSI X3.72-1981).

aa. ISO International Register of Character Sets to be Used with Escape Sequences, maintained and available without charge from the Registration Authority for ISO 2375 (Related Document e. above): European Computer Manufacturers Association (ECMA), Rue du Rhone 114, CH-1204 Geneva, Switzerland (the mailing address must include a specific name of a person in each agency requesting a copy of the

register and its updates which are issued by ECMA as new sets become registered).

Applicability: This standard is applicable to Federal acquisition and use of data processing or communication systems, data systems, system components, and related equipment that may be required to interchange character coded information, or represent control characters.

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Implementation: All equipment and coded character information to which this standard is applicable that is brought-into the Federal Government inventory on or after the November 14, 1984 effective date of this FIPS PUB must be in conformance with this standard unless a waiver has been obtained in accordance with the waiver provisions given below. The superseded FIPS PUBS still apply according to their terms to systems, equipment and information obtained before the effective date of this FIPS PUB.

More efficient use of magnetic tape and other media for locally maintained installation files is sometimes realized by the use of non-standard techniques (e.g., packed numerics, floating point, pure binary). Where interchange of information external to the immediately local environment is not a consideration, local use of such techniques may be employed without a waiver.

The use of subsets of fewer than the 128 characters of ASCII must be in accordance with the section on the specification of subsets included in this FIPS PUB. The use of extended sets in 7-bit form employing alternate assignments of the 128 binary patterns of ASCII must be accomplished in accordance with ANSI X3.41 which also is adopted by this FIPS PUB. The use of expanded sets in 8-bit form, having 256 binary patterns available, must also be accomplished in accordance with ANSI X3.41. Extended and expanded sets, wherever possible, must be in conformance with a set registered in the ISO International Register of Character Sets to be Used with Escape Sequences as noted in Related Document aa.

Additional control functions for character-oriented equipment and data systems are now governed by FIPS PUB 86.

Specifications: This standard adopts in whole three American National Standards:

- a. American National Standard X3.4-1977, Code for Information Interchange (ASCII).
- b. American National Standard X3.32-1973, Graphic Representation of the Control Characters of American National Standard Code for Information Interchange.
- c. American National Standard X3.41-1974, Code Extension

Techniques for Use with the 7-Bit Coded Character Set of American National Standard Code for Information Interchange.

This standard also specifies three graphic character subsets of ASCII, in "Specifications for Subsets of the Standard Code for Information Interchange," included in this FIPS PUB. The three subsets are:

Figure 1-95-Character Graphic Subset

Figure 2-64-Character Graphic Subset

Figure 3-16-Character Graphic Numeric Subset

These three subsets are derived from the 128-character set of the American National Standard Code for

Information Interchange (ASCII, ANSI X3.4-1977).

In order to facilitate the interchange of data and equipment at the subset level within the Federal Government, it is essential to limit the use of subsets to the three described in this FIPS PUB. Each subset is intended to be used in those applications whose needs are adequately served by that subset.

Waivers: If instances arise in which an agency cannot comply with the provisions of this FIPS PUB, the head of the agency is authorized to waive its application. Generally, two conditions apply in those exceptional cases which would warrant a waiver:

a. Significant, continuing cost or efficiency disadvantages will be encountered by the use of this standard and,

b. The interchange of information with other systems is not anticipated.

Notification of approved waivers shall be sent to the Director, Institute for Computer Sciences and Technology, National Bureau of Standards, Gaithersburg, MD 20899.

Special Information: FIPS PUB, Code for Information Interchange, was first issued in 1968, adopting the then current ASCII standard, X3.4-1968, except for the so-called "New Line option." The first revision, FIPS PUB 1-1, was issued in 1980, adopting in whole the current version of ASCII, ANSI X3.4- 1977, including the New Line option. FIPS PUB 7, Implementation of the Code for Information Interchange and Related Media Standards, was published in 1969 and was in effect until it was superseded by the issuance of this FIPS PUB 1-2.

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FIPS PUB 7 did not adopt a standard, but was developed to provide implementation guidance for Federal agencies. FIPS PUB 15, Subsets of the Standard Code for Information Interchange, was issued in 1971 and was based in part upon a draft voluntary standard for graphic subsets of ASCII which has not since been approved as an American National Standard; as a consequence, the specifications for subsets of ASCII are not available as an ANSI-publication but are included as a section of this document. FIPS PUB 35, Code Extension Techniques in 7 or 8 Bits, was issued in 1975, adopting in whole ANSI X3.41-1974. FIPS PUB 36, Graphic Representation of the Control Characters of ASCII, was also issued in 1975, adopting in whole ANSI X3.32-1973 Section 8 of FIPS PUB 7 discusses the use of subsets, extended sets (in 7 bits), expanded sets (in 8 bits) and registration of extended and expanded sets by NBS. Since adoption of FIPS PUB 7, NBS has not registered any such sets. Subsequently, an international registry of character sets to be used with ISO 646 (similar to ASCII) Escape sequences has been established. The international Registration Authority is currently the European Computer Manufacturers Association (ECMA). See Related Document aa. above.

Where to Obtain Copies: Copies of this publication are available for sale from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161. (Sale of the included specifications documents is by arrangement with the American National Standards Institute.) When ordering, refer to Federal Information Processing Standards Publication 1-2 (FIPSPUB1-2), and title. Payment may be made by check, money order, or deposit account.

Ordering information for the ISO International Register of Character Sets to be Used with Escape Sequences, is provided in paragraph aa. of the Related Documents provision.

Federal Information
Processing Standard Publication 1-2
1984 November 14
Specifications for

SUBSETS OF THE STANDARD CODE
FOR INFORMATION INTERCHANGE

Specifications. This specification provides standard subsets of the Code for Information Interchange which was adopted from the American National Standard Code for Information Interchange (ASCII). Each subset is defined in detail in separate sections of this specification which follow.

Section 1-95-Character Graphic Subset

Section 2-64-Character Graphic Subset

Section 3-16-Character Graphic Numeric Subset

Appendix. Factors which are considered in the establishment of these subsets are explained in an appendix to this specification. Also, information is provided concerning the employment of these subsets in computers and devices based on internal codes of four or six bits.

Section 1

SPECIFICATIONS FOR 95-CHARACTER GRAPHIC CHARACTER SUBSET

Explanation. This graphic character subset is derived from the Code for Information Interchange which was adopted from the American National Standard Code for Information Interchange (ASCII). This character subset is intended to be used in those systems or applications whose needs are adequately served by a 95-character graphic subset of the standard 128-character set contained in ASCII. This 95-character graphic subset contains all of the characters in columns 2, 3, 4, 5, 6 and 7 of the ASCII code table, except the character Delete (DEL) in position 7/15. Figure 1 shows the 7-bit code table of ASCII with the 95-character graphic subset of this standard outlined. It is emphasized that the coded representation of this 95-character subset in input/output media and data communications will conform to the specifications cited in other applicable Federal Information Processing Standards.

[illegible]

more rapid growth. In fact, the annual growth rate of the

Section 2
SPECIFICATIONS FOR 64-CHARACTER GRAPHIC CHARACTER SUBSET

Explanation. This graphic character subset is derived from the Code for Information Interchange which was adopted from the American National Standard Code for Information Interchange (ASCII). This character subset is intended to be used in those systems or applications whose needs are adequately served by a 64-character graphic subset of the standard 128-character set contained in ASCII. This 64-character graphic subset contains all of the characters in columns 2, 3, 4 and 5 of the ASCII code table. Figure 2 shows the 7-bit code table of ASCII with the 64-character graphic subset of this standard outlined. It is emphasized that the coded representation of this 64-character subset in input/output media and data communications will conform to the specifications cited in other applicable Federal Information Processing Standards.

[illegible]

Figure 2. Code for Information Interchange® showing 64-character graphic subset.

Section 3

SPECIFICATIONS FOR 16-CHARACTER GRAPHIC NUMERIC SUBSET

Explanation. This numeric subset is derived from the Code for Information Interchange which was adopted from the American National Standard Code for Information Interchange (ASCII). This subset is intended to be used in those systems or applications whose needs are adequately served by a 16-character numeric subset of the standard 128-character set contained in ASCII. This 16-character graphic numeric subset contains the ten numerals from the top ten positions of column 3 and six symbols Asterisk, Plus, Comma, Hyphen (Minus), Period (Decimal Point) and Slant, from the bottom six positions of column 2. Figure 3 shows the 7-bit code table of ASCII with the 16-character graphic subset of this standard outlined. It is emphasized that the coded representation of this 16-character subset in input/output media and data communications will conform to the specifications cited in other applicable Federal Information Processing Standards.

Special Information. Systems and applications employing this limited 16-character set, when receiving information via standard media or communications from systems employing the full 128-character set, the 95-character graphic set or the 64-character graphic subset, should ignore all characters outside of this numeric subset. This feature is desirable in most instances, but is not mandatory for applications requiring some other interpretation of the characters outside of this numeric subset.

[illegible]

Figure 3. Code for Information Interchange showing 16-character numeric subset.

APPENDIX

The Code for Information Interchange which adopts the American National Standard Code for Information Interchange (ASCII) contains 128 characters of which 95 in the last six columns (columns 2 through 7) are designated as a graphic subset. Contained in this graphic subset are two cases (upper and lower) of the alphabetic letters A through Z, the numerals 0 through 9, and common punctuation, mathematical, and business symbols.

Not all applications have need for the full 128 characters contained in the standard code set. Some require only the graphics (95 characters). Others need only use a single case alphabet, the numbers, and certain special symbols (64 characters). Further, some applications dealing with data of a mathematical or numeric nature need only the numerics and certain mathematical symbols (16 characters).

Accordingly, it is necessary to recognize the economies to be achieved in providing adequate subsets of the standard code which are consistent with the requirements of these various applications. Likewise, it is essential in order to facilitate the interchange of data and equipment within the Federal Government that a family of discrete subsets be identified and standardized. The consequences and costs of an unlimited number of subsets are of such a magnitude that it is reasonable and practical to establish a limited group of subsets which meet most data systems requirements. This fundamental consideration was taken into account in the development of the standard code for information interchange. Characters were positioned in the Code in such a manner as to facilitate the identification and use of subsets. Columns 2 through 7 form the 95-character graphic subset. Columns 2 through 5 provide a 64-character subset. The 10 numerals in column 3 and the six mathematical symbols at the bottom of column 2 provide the 16-character numeric subset. (These six mathematical symbols were placed in column 2 instead of column 3 so that they would collate lower than the numerals in the context of the full character set. Also they were assigned to the bottom of the column so that their low order four bits are distinct from the low order four bits of the 10 numerals, in order to be distinguishable in those instances where numerics are coded by four bits in internal machine environments without further manipulation.)

It is also recognized that certain computers and devices already in the Federal inventory are based upon an internal code of four or six bits. In these instances the standard code can be represented internally by six bits by suppressing bit b6, and can be represented by four bits by suppressing bits b7, b6, and b5. These

limited internal representations are then expanded to the standard seven bits when transmitting data to other devices.

12

Technical Publications

Periodical

Journal of Research-The Journal of Research of the National Bureau of Standards reports NBS research and development in those disciplines of the physical and engineering sciences in which the Bureau is active. These include physics, chemistry, engineering, mathematics, and computer sciences. Papers cover a broad range of subjects, with major emphasis on measurement methodology and the basic technology underlying, standardization. Also included from time to time are survey articles on topics closely related to the Bureau's technical and scientific programs. As a special service to subscribers each issue contains complete citations to all recent Bureau publications in both NBS and non-NBS media. Issued six times a year.

Nonperiodical

Monographs-Major contributions to the technical literature on various subjects related to the Bureau's scientific and technical activities.

Handbooks-Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

Special Publications-Include proceedings of conferences sponsored by NBS, NBS annual reports, and other special publications appropriate to this grouping such as wall charts, pocket cards, and bibliographies.

Applied Mathematics Series-Mathematical tables, manuals, and studies of special interest to physicists, engineers, chemists, biologists, mathematicians, computer programmers, and others engaged in scientific and technical work.

National Standard Reference Data Series-Provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NBS under the authority of the National Standard Data Act (Public Law 90-396). NOTE: The Journal of Physical and Chemical Reference Data (JPCRD) is published quarterly for NBS by the American Chemical Society (ACS) and the American Institute of Physics (AIP). Subscriptions, reprints, and supplements are available from ACS, 1155 Sixteenth St., Nw, Washington, DC 20056.

Building Science Series-Disseminates technical information developed at the Bureau on building materials, components, systems, and whole structures. The series presents research results, test

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Technical Notes Studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NBS under the sponsorship of other government agencies.

Voluntary Product Standards-Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The standards establish nationally recognized requirements for products, and provide all concerned interests with a basis for common understanding of the characteristics of the products. NBS administers this program as a supplement to the activities of the private sector standardizing organizations.

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